GP-307707

Hinge Assembly

Description

The invention relates to a hinge assembly with a lever, which has two head pieces on the ends of the lever, each able to swivel around one axis for mounting of the lever onto a door, a hood or a frame. The invention relates especially to a hinge assembly for a plug door with parallel swivelling out behavior, a so-called pantograph door.

Such doors are increasingly found nowadays in buses. The reason being that with a plug door, when swivelling out the door, an entire door opening width is freed, similar to a sliding door. In contrast to conventional doors this allows frail and handicapped persons easier getting on and off in tight parking spaces.

It is known to implement swinging out pantograph doors which are parallel to the side panel of the vehicle with a hinge assembly, which include levers which can swivel around different axes. As is known at least two levers are required of which are acting one weight-arm named lever as a positioning element and one control lever named lever as an orientation element. The disadvantage of such a hinge assembly with several levers is an increased space requirement based on multiple lever connections on the door and the frame. The levers are mainly found in the entrance area and are extremely bothersome, especially close to the floor. In addition it is a disadvantage that in the case of an accident the levers can bend which leads to deadlocks, which can interfere with or make impossible the opening of the door in an emergency.

The object of the present invention is to create a hinge assembly for a plug door or a hood, which can be done with a small number of levers and avoids the above mentioned disadvantages.

According to the invention the object is solved by a hinge assembly with the characteristics of Claim 1.

The levers of the hinge assembly according to the invention correspond to the weight-arm of known pantograph doors, while the tension members take over the function of the orientation lever. Thereby the tension members can be located nearly adjacent to the levers or lie close to these, so that no additional space is required and the total hinge assembly requires less space than known hinge assemblies. Furthermore deadlocks from accidents in which the levers are bent can be almost completely avoided if the invention is designed with shape changing tension members such as chains or V-belts, whereby a vehicle with a door which has a hinge assembly according to the invention is significantly safer than vehicles with doors having conventional hinge assemblies.

With a preferred embodiment of the invention the bodies are rotatingly coupled to the correspondingly located head piece with the same transmission ratio, whereby the contact points have the same distance from the plane. Thereby at least one of the head pieces can contain one bodies wound around with the contiguously connected tension members. The bodies can be connected with the head piece of the respective end so that a movement of the tension members drives a rotation of the head piece. In such a case preferably at least one of the tension members runs tangentially off of a wound around surface of the body. This is implemented in that the body is designed as a circular disk. If the contact points have the same distance from the plane and shaped bodies are provided on both ends of the lever disk, this means that for disk shaped bodies, the bodies have identical diameters.

In an activation of the hinge assembly, while the lever is swivelled, the contact points travel along a surface of the body in such an embodiment of the invention, since they change when turning the lever by the surface of the body wound around with the tension members. It is however impossible for the contact points of any of the lever positions to change sides of the plane. The tension members transfer a rotational movement of a head piece through the lever away to the other head piece, so that with a plug door with such a hinge assembly a parallel swinging up behavior is implemented.

Circumferential areas of such circular disks which never come into contact with the tension members with the rotational movement of the lever can be

eliminated, so that a circular sector shape for the wound around body also comes into consideration.

For the body this can be, for example, a toothed gear, whose teeth engage with the tension members. Then it can be advantageously a matter of chains for the tension members, which have chain links for engagement with the teeth of the toothed gear, or however of belts or chains with links which have teeth on them so that the teeth of the belt or chain engage with the teeth of the toothed gear.

Preferably the axis of the head piece coincides with the rotational axis of the respectively assigned body. Then it is possible to design the body with the assigned head piece as a rigid unit.

It is also possible to connect the tension members contiguously in an endless loop.

In another embodiment the body is connected with the respective head piece using a series of gears, for example a planetary gear or another toothed gear arrangement. Hereby the series of gears can have different transmission ratios between the body and the head piece. The larger the transmission ratio is, the faster the endless loop of the tension members circulate with a swivelling movement and the smaller the forces are which are transferred at the same time, i.e. the smaller is an internal stress of the lever which occurs if a swivelling movement works against an outside counter force. This reduced internal stress enables the lever to be built lightweight and therefore economically.

In an especially preferable embodiment the lever is shaped bent in at least one angle. The lever is here especially advantageous if formed in an L-shape. Plug doors with such a hinge assembly achieve thereby a larger door opening angle, since the lever in the swivelled open condition of the door lies with a bent section on one of the door opening surrounding outer side panels and also the door can be brought closer to the side panel with this method. In such an embodiment of the lever, diverting elements for the tension members arranged on the angle are especially preferred, in order to guarantee with the shape of the lever an aligned running of the tension members for the reduction of the required space.

In a further preferred embodiment of the invention the lever is designed hollow, and the tension members and the wound around body are contained in it. In this manner moving parts are covered and protected. As a further advantageous effect of this embodiment the lever can even take over additional functions, as for example if it is used as an arm rest.

It is possible to design a combined hinge assembly, in which a plurality of hinge assemblies according to the invention are connected together. Such a combined hinge assembly is for example an advantage for high doors, in which the hinge assemblies according to the invention are positioned at different heights. Such a combined hinge assembly proves to be especially sturdy.

For a door with a plurality of hinge assemblies according to the invention or with combined hinge assemblies the levers are mounted with one of the first of its head pieces on the door and arranged staggered in such a manner that their first and second axes respectively coincide.

If the door with the hinge assembly according to the invention part of an automobile, the levers are mounted with a second of their head pieces on a frame of this automobile. This door can be preferably an upward folding wing door with essentially horizontal swiveling axes, but also a door with vertical swiveling axes, such as on a bus.

The hinge assembly according to the invention can also be used with hoods such as for example engine hoods or trunk lids of automobiles, in order to equip them with parallel swinging out behavior.

The invention is explained in detail in the following based on two preferred embodiments. The figures show:

Fig. 1 a door with a hinge assembly according to the invention in closed state;

Fig. 2 the door from Fig. 1 in opened state;

Fig. 3 a door with an alternatively designed hinge assembly according to the invention in closed state;

Fig. 4 the door from Fig. 3 in opened state;

Fig. 5 an engine hood with the hinge assembly from Fig. 1 in opened state;

Fig. 6 an end section of the lever with series of gears;

Fig. 7 an end section of the lever with planetary series of gears;

Fig. 8 an automobile with a door which swings out upward; and

Fig. 9 the automobile from Fig. 8 with opened door.

A door 1 for an automobile with a hinge assembly according to the invention 2 is represented in section in Fig. 1 in a closed state. The door 1 closes in this state flush with a side panel 3 of the automobile. The hinge assembly 2 contains a hollow lever 6, which to simplify matters is represented with the cover taken off, two head pieces 4 and 5 located on the ends of the lever 6, which each swivel around an axis perpendicular to the plane of the figure as well as within the lever 6 an arranged chain or a toothed belt 7 in the form of an endless loop. In order to give the head pieces 4, 5 the possibility to swivel, a side panel of the hollow lever 6 is noncontiguous on each of its ends. On the head piece 4 a circular disk 10 is non-rotatably connected, and a circular disk 11 is non-rotatably connected with the head piece 5. Both disks 10, 11 are located within the hollow lever 6. Thereby the disk 10 is centered on the swivelling axis of the head piece 4 and the disk 11 on the swivelling axis of the head piece 5. The disks 10 and 11 are wound around by the toothed belt 7, whose teeth engage in the complementary gaps of disk 10, whereby a coupling is made between the disks 10 and 11 and therefore between the head pieces 4 and 5. The head piece 4 is here fastened onto the door 1 and rigidly connected to it, while the head piece 5 is fastened on an inner projection 14 of the side panel 3 with the head piece 4 in the opposite direction. Thereby the lever 6, and a plane running through the axes of the head pieces 4 and 5, are aligned parallel to the door 1. In this orientatation a contact point 12 results for the toothed belt 7, on which the toothed belt 7 engages the disk 10 on the side opposite of the door 1 and a contact point 13, on which the toothed belt 7 engages disk 11 on the side facing the door 1. Complementary contact points to the contact points 12 and 13 of the toothed belt 7 are hidden in the illustration of head pieces 4 and 5. Thereby the contact point 12 as well as its hidden complementary contact point are found on different sides of the

plane running through the axes of head pieces 4 and 5. The same applies to the contact point 13 as well as its complementary, hidden contact point. Since the diameters of the disks 10, 11 are equal, the distance of all the contact points from this plane are equal.

In Fig. 2 the door from Fig. 1 is represented in the opened state. During the swiveling movement from the illustrated position of Fig. 1 into the illustrated position of Fig. 2, the head pieces 4 and 5 are swiveled around their respective axes on the end of the lever 6. As a result of the rigid design of the disks 10 and 11 with their respective head pieces 4 and 5, the toothed belt 7 circulates around the disks 10 and 11 during the swivelling movement. Thereby the tension member 8 of the toothed belt 7 runs on the headpiece 4 and the tension member 9 on the headpiece 5. As a result of this movement the contact points 12 and 13 move along the disks 10 and 11, so that they take the new positions on the disks 10 and 11 shown in Fig. 2. Also the complementary contact points 16 and 17 to the contact points 12 and 13 change their position on disks 10 and 11, so that they are visible in Fig. 2 at the shown positions. Hereby the contact point 12 and the contact point 17 are found on one side of this plane, while the contact points 13 and 16 are located on the opposite side. During the circulation of the toothed belt 7, a torque on the axis of the head piece 4 is exerted on the disk 10. Through the rigid design of the disk 10 with the head piece 4 and the fixed mounting of the head piece 4 on the door 1, this torque is transferred to the door 1, so that the door 1 holds its parallel alignment to side panel 3 during the entire swiveling movement as well as in the swiveled out state of Fig. 2.

An alternative embodiment of the hinged assembly 2 with angled lever 6 is shown in Fig. 3. The lever 6 is L-shaped in this embodiment. In contrast to the embodiment described above, the orientation of the head piece 5 is perpendicular to the orientation of head piece 4. Head piece 5 is mounted on a surface of the side panel 3 perpendicular to the door 1. On the angle of lever 6 there are guide rollers 15 located, around which the tension members 8 and 9 of the toothed belt 7 are guided. Through this the toothed belt 7 loses a parallel circulation to the lever 6, which makes it possible to house the toothed belt in the inside of the hollow lever 6. Also here the contact points 12, 16 and 13, 17 of the tension members 9 and 6 lie on the disks 10

and 11 on different sides of the plane running through the axes of the head pieces 4 and 5.

Fig. 4 shows the door 1 with the hinge assembly 2 shown in Fig. 3 with the angled lever 6 in the opened state. This presents the functionality of this hinge assembly 2 during the swiveling movement of the lever 6 with reference to the hinge assembly described in figures 1 and 2 and should not be repeated here again. As can however be seen in Fig. 4, the special advantage of the angled lever 6 is that the opened door 1 in the opened state lies closer to the side panel 3 and therefore frees the entire door opening width in the side panel 3.

The toothed belt 7 can be easily replaced by a suitable chain, like a toothed chain or a roller chain, in whose spaces between links the teeth of the disks 10, 11 then designed as toothed gears can engage.

A further example for the use of the hinge assembly according to the invention is shown in Fig. 5. Here a schematic drawing is seen of a front area of an automobile 23 with opened engine hood 16. The engine hood 16 is fastened with the hinge assembly 2 represented in figures 1 and 2 onto the frame of the automobile 23. Based on the hinge assembly 2 the engine hood 16 swings up parallel when opening and in the opened state takes the position shown in Fig. 5 with the same alignment as in the closed state. The equivalent is also possible for a trunk lid of the automobile 23.

Instead of the way shown in Figures 1 to 4, to let the toothed belt 7 engage onto the head pieces 4, 5 using disks 10, 11 non-rotatably connected to them, as is seen in the enlarged illustration of an end area of the lever 6 of Fig. 6, the head pieces 4, 5 can be coupled to the disks 10, 11 using a series of gears. A toothed gear 19 which is rigidly fixed to the disk 10 is provided coaxial to disk 10, which is engaged with a toothed gear 20 which is rigidly attached to the head piece 4. The toothed gears 19, 20 act like a series of gears, which transfers a torque form the disk 10 to the head piece 4. The series of gears has a transmission ration of over 1, i.e. the disk 10 rotates faster than the head piece 4. The toothed belt 7 circulates faster therefore with this embodiment in the interior of lever 6 than with the levers of Fig. 1 to 4. The force transferred from the toothed belt 7 is consequently reduced, so that a

desired mechanical stability under load of the lever 6 is already achievable with a lower strength of its housing.

If the transmission ratios of the series of gears on both ends of the lever are equal, the swinging out behavior of a door or hood fastened to head piece 4 is parallel.

Alternative to the shown embodiment of Fig. 6 the disk 10 can also be coupled with the head piece 4 using a planetary series of gears, as is schematically represented in a side section in Fig. 7. The disk 10 is there non-rotatably connected with a sun gear internal gear 25 of the planetary series of gears 24. An internal gear 27 is rigidly connected with the housing of the lever. Planetary gears 26 are engaged with the internal gear 27 and the sun gear 25 and are held by a planetary carrier non-rotatably connected with the head piece 4. When the head piece 4 swivels relative to lever 6, the planetary gears circulate in their track and in doing so drive a rotation of the sun gear 25.

As a further example Fig. 8 shows a section through a part of an automobile with an upward folding wing door 21, which in its upper area is fastened with a hinged assembly according to the invention 22 onto a frame of the automobile. The axes of rotation of the hinged assembly are horizontal, so that they guide the door 21 in an essentially vertical movement. In Fig. 8 the door 21 is shown in a closed state. The hinge assembly 22 has a long curved lever 6. Thanks to the length of the lever 6, the door 21 swings open wide enough, as shown in Fig. 9, to allow entrance into the automobile.